Electrical and Thermoelectrical Properties of $TlMnS_2$ and $TlMnSe_2$

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The synthesis regimes of $TlMnSe_2$ and $TlMnS_2$ phases have been worked out. X-ray analysis showed that $TlMnS_2$ is crystallized in tetragonal structure with elementary cell parameters a=7.74; c=30.60≈; roentgen density ρ_x=6.40 g/cm^3. $TlMnSe_2$ is crystallized in hexagonal structure with elementary cell parameters a=6.53; c=23.96≈; z=8; ρ_x=6.71 g/cm^3.

The electric and thermoelectric properties of $TlMnSe_2$ and $TlMnS_2$ were studied. In the temperature range 130 - 315 K, temperature dependence of the conductivity (σ) of $TlMnS_2$ increases exponentially with increasing temperature, i.e. σ(T)- dependence had a semiconductor nature. It was shown that σ(T)-dependence of $TlMnS_2$ consists of three various regions with following activation energies: 0.178, 0.08 and 0.44eV.

The temperature dependence of the conductivity of $TlMnSe_2$ had a metallic nature. Temperature dependence of the thermoelectromotive force (α) in $TlMnSe_2$ was studied. The thermo-e.m.f. sign corresponded to the p-type conductivity of $TlMnSe_2$ in the temperature range 88 - 300K. With increasing temperature from 88 to 300K, the value of the thermo- e.m.f. in $TlMnSe_2$ increased from 77 to 200 μV/K. At T=194K an anomaly was revealed in the dependence α(T).

The low-temperature branch of α(T)- dependence in $TlMnSe_2$ had a linear character with extrapolation to T=0 according to metallic formula for thermo-e.m.f.:

$$\alpha(T) = \frac{\pi^2}{3} \cdot \frac{k^2 T}{e} \left(\frac{\partial \ell n \sigma}{\partial E} \right)_{E=E_F},$$

where k is Boltzmann constant; e-electron charge; E_F-Fermi energy and $kT<<E_F$.